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**International Conference on
Soft Computing, Intelligent System
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Soft Computing, Intelligent System and Information Technology

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Editors:
Leo Willyanto Santoso
Andreas Handojo



Informatics Engineering Department
Petra Christian University

Center of Soft Computing and
Intelligent System Studies

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International Conference on Soft Computing, Intelligent System and Information Technology 2010

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Table of Contents

Preface.....	xi
Organizing Committee.....	xii
Program Committee.....	xiii
Human Language Technology: The Philippine Context	1
<i>Rachel Edita Roxas, Allan Borra</i>	
Hybrid-Multidimensional Fuzzy Association Rules from a Normalized Database.....	10
<i>Rolly Intan</i>	
Fuzzy Systems & Neural Networks	
A Context-Based Fuzzy Model for a Generator Bidding System.....	18
<i>Moeljono Widjaja</i>	
Neural Networks for Air-Conditioning Objects Recognition in Industrial Environments	24
<i>Enrique Dominguez, J.J. Carmona</i>	
Pattern Recognition Using Discrete Wavelet Transformation and Fuzzy Adaptive Resonance Theory.....	29
<i>Arnold Aribowo, Samuel Lukas, Joannes Franciscus</i>	
Resolving Occlusion in Multi-Object Tracking using Fuzzy Similarity Measure	33
<i>Rahmatri Mardiko, M. Rahmat Widyanto</i>	
Search Engine Application using Fuzzy Relation Method for e-Journal of Informatics Department Petra Christian University	39
<i>Leo Willyanto Santoso, Rolly Intan, Prayogo Probo Susanto</i>	
The Use of Gabor Filter and Back-Propogation Neural Network for the Automobile Types Recognition	45
<i>Gregorius Satia Budhi, Rudy Adipranata, Fransisco Jimmy Hartono</i>	
Genetic Algorithm & Applications	
Comparing Genetic and Ant System Algorithm in Course Timetabling Problem	51
<i>Djasli Djamarus</i>	

Gas Distribution Network Optimization with Genetic Algorithm.....	57
<i>K.A. Sidarto, L.S. Riza, C.K. Widita, F. Haryadi</i>	
Hybrid Genetic Algorithm for Solving Strimko Puzzle	63
<i>Samuel Lukas, Arnold Aribowo, James Nagajaya Dyalim</i>	
Optimal Design of Hydrogen Based Stand-Alone Wind/Microhydro System Using Genetic Algorithm	66
<i>Soedibyo, Heri Suryoatmojo, Imam Robandi, Mochamad Ashari, Takashi Hiyama</i>	
Optimization of Steel Structure by Combining Evolutionary Algorithm and SAP2000.....	71
<i>Mohammad Ghazi, Pujo Aji, Priyo Suprobo</i>	
The Hydrophobic-Polar Model Approach to Protein Structure Prediction	77
<i>Tigor Nauli</i>	
University Course Scheduling Using the Evolutionary Algorithm	81
<i>Ade Jamal</i>	
 Artificial Intelligence & Applications	
Implementation of Academic Advisor Expert System, At University of Al Azhar Indonesia.....	86
<i>Zulfikar, Nidaul Hasanati</i>	
Adaptive Appearance Learning Method using Simulated Annealing	91
<i>Du Yong Kim, Ehwa Yang, Moongu Jeon, Vladimir Shin</i>	
Bayesian Network and Minimax Algorithm in Big2 Card Game.....	96
<i>Nur Ulfa Maulidevi, Hengky Budiman</i>	
Cell Formation Using Particle Swarm Optimization (PSO) Considering Machine Capacity, Processing Time, and Demand Rate Constraints	102
<i>Dedy Suryadi, Ferry Putra, Cynthia Juwono</i>	
Computer Aided Learning for List Implementation in Data Structure.....	108
<i>Ng Melissa Angga, Susana Limanto</i>	
Development Weightless Neural Network on Programmable Chips to Intelligent Mobile Robot.....	112
<i>Siti Nurmaini, Bambang Tutuko</i>	
If-Statement Modification for Single Path Transformation: Case Study on Bubble Sort and Selection Sort Algorithms	116
<i>Rahmadi Trimananda</i>	

Implementation of Particle Swarm Optimization Method in K-Harmonic Means Method for Data Clustering	120
<i>Ahmad Saikhu, Yoke Okta</i>	
Implementation of Starfruit Maturity Classification Algorithm.....	127
<i>R. Amirulah, M.M. Mokji, Z. Ibrahim</i>	
Improving Choquet Integral Agent Network Performance by using Competitive Learning Algorithms	132
<i>Handri Santoso, Shusaku Nomura, Kazuo Nakamura</i>	
Improving Food Resilience with Effective Cropping Pattern Planning using Spatial Temporal-Based Updated Pranata Mangsa.....	138
<i>Kristoko Dwi Hartomo, Sri Yulianto J.P., Krismiyati</i>	
Knowledge Based System in Defining Human Gender Based On Syllable Pattern Recognition	143
<i>Muhammad Fachrurrozi</i>	
Maintaining Visibility of a Moving Target: The Case of an Adaptive Collision Risk Function.....	146
<i>Ashraf Elnagar, Ibrahim Al-Bluwi</i>	
Measuring Interesting Rules in Characteristic Rule	152
<i>Spits Warnars</i>	
MIDI Composition Tools using JFugue Java API.....	157
<i>Kartika Gunadi, Liliana, Hendra Kurnia Wijaya</i>	
Mobile-based Interaction using Djikstra's Algorithm for Decision Making in Traffic Jam System ...	159
<i>Puji Sularsih, Egy Wisnu Moyo, Fitria H. Siburian, Sigit Widiyanto, Dewi Agushinta R.</i>	
Model and Boarding Simulation for Reducing Seat and Aisle Interferences Between Passenger	164
<i>Bilqis Amaliah, Victor Hariadi, Antonius Malem Barus</i>	
Optimizing Rijndael Cipher using Selected Variants of GF Arithmetic Operators.....	170
<i>Petrus Mursanto</i>	
PCR Primer Design using Particle Swarm Optimization Combined with Piecewise Linear Chaotic Map	176
<i>Cheng-Hong Yang, Yu-Huei Cheng, Li-Yeh Chuang</i>	
Performance Analysis of Heterogeneous Computer Cluster	182
<i>Abdusy Syarif, Saiful Ikhwan, Muhammad Risky</i>	
Reduced Space Classification using Kernel Dimensionality Reduction for Question Classification in Public Health Question-Answering	187
<i>Hapnes Toba, Ito Wasito</i>	

The Developing of Interactive Software for Supporting the Kinematics Study on Linear Motion and Swing Pendulum.....	193
<i>Liliana, Kartika Gunadi, Yonathan Rindayanto Ongko</i>	

University Timetabling Problems with Customizable Constraints using Particle Swarm Optimization Method	197
<i>Paulus Mudjihartono, Wahyu Triadi Gunawan, The Jin Ai</i>	

Knowledge & Data Engineering

A Design of Multidimensional Database for Content-based Television Video Commercial Mining.....	201
<i>Yaya Heryadi, Yudho Giri Sucahyo, Aniati Murni Arymurthy</i>	

Applying Sound to Enhance the Comprehension of Sorting Algorithms.....	206
<i>Lisana, Edwin Pramana</i>	

Data Mining to Build a Pattern of Knowledge from Psychological Consultations	211
<i>Sri Mulyana, Sri Hartati, Retantyo Wardoyo, Edi Winarko</i>	

Data Warehouse Information Management System RSU Dr. Soetomo for Supporting Decision Making.....	215
<i>Silvia Rostianingsih, Oviliani Yenti Yuliana, Gregorius Satia Budhi, Denny Irawan</i>	

Development of an Electronic Medical Record (EMR) in Stayed Nursing Installation.....	220
<i>Eko Handoyo, Aghus Sofwan, Mohammad Muttaqin</i>	

Development of Supporting Sales Analysis Application using Frequent Closed Constraint Gradient Mining Algorithm (FCCGM)	224
<i>Susana Limanto, Dhiani Tresna Absari</i>	

Implementation of KMS to Integrate Knowledge Management and Supply Chain Management Process	229
<i>Vivine Nurcahyawati, Retno Aulia Vinarti, Mudjahidin</i>	

Indonesian WordNet Sense Disambiguation using Cosine Similarity and Singular Value Decomposition	234
<i>Syandra Sari, Ruli Manurung, Mirna Adriani</i>	

Influence of Electronic Media and External Reward Towards Knowledge Sharing Management to Learning Process in Higher Education Institution	240
<i>Alexander Setiawan</i>	

Information and Technology Outsourcing Vendor Selection: An Integrative Literature Review.....	245
<i>Jimmy</i>	

Information Retrieval on MARC Metadata	251
<i>Adi Wibowo, Rolly Intan, Irawan Arifin</i>	
Learning Management Systems' Integration	256
<i>N.S Linawati, Putra Sastra, P.K. Sudiarta</i>	
Mining Sequential Pattern on Sequential Data of Paint Sales Transaction Flow	260
<i>Agustinus Noertjahyana, Gregorius Satia Budhi, Henny Kusumawati Wibowo</i>	
Modeling School Bus for Needy Student Using Geographic Information System.	265
<i>Daniel Hary Prasetyo, Jamilah Muhamad, Rosmadi Fauzi</i>	
Optimization SQL Server 2005 Query using Cost Model and Statistic	272
<i>Ibnu Gunawan</i>	
Spatial Autocorrelation Modelling for Determining High Risk Dengue Fever Transmission Area in Salatiga, Central Java, Indonesia	277
<i>Sri Yulianto J.P., Kristoko Dwi Hartomo, Krismiati</i>	
Supply Chain Improvement with Design Structure Matrix Method and Clustering Analysis (A Case Study)	281
<i>Tanti Octavia, Siana Halim, Stefanus Anugraha Lukmanto, Harvey Sutopo</i>	
The Comparation of Similarity Detection Method on Indonesian Language Document	285
<i>Anna Kurniawati, Lily Wulandari, I Wayan Simri Wicaksana</i>	
The Effects of Training Documents, Stemming, and Query Expansion in Automated Essay Scoring for Indonesian Language with VSM and LSA Methods.....	290
<i>Heninggar Septiantri, Indra Budi</i>	
The Impact of Object Ordering in Memory on Java Application Performance	296
<i>Amil A. Ilham, Kazuaki Murakami</i>	
Using Data Mining to Improve Prediction of 'No Show' Passenger on an Airline Reservation System.....	302
<i>Johan Setiawan, Bobby Limantara</i>	
Using Frequent Max Substring Technique for Thai Keyword Extraction used in Thai Text Mining	309
<i>Todsanai Chumwatana, Kok Wai Wong, Hong Xie</i>	
Using the End-User Computing Satisfaction Instrument to Measure Satisfaction with Web-Based Information Systems	315
<i>Dedi Rianto Rahadi</i>	

Imaging Technology

Batik Image Classification using Log-Gabor and Generalized Hough Transform Features	320
<i>Laksmita Rahadiani, Hadaig R. Sanabila, Ruli Manurung, Aniati Murni</i>	
Burrows Wheeler Compression Algorithm (BWCA) in Lossless Image Compression	326
<i>Elfitrin Syahrul, Julien Dubois, Vincent Vajnovszki, Asep Juarna</i>	
Comparison of Random Gaussian and Partial Random Fourier Measurement in Compressive Sensing Using Iteratively Reweighted Least Squares Reconstruction	332
<i>Endra</i>	
Developing a Video Player Application for Phillips File Standard for Pictoral Data Format (NXPP): A Project View Approach	335
<i>Eko Handoyo, Restiono Djati Kusumo</i>	
Development Edge Detection Using Adhi Method, Case Study: Batik Sidomukti Motif	340
<i>Adhi Pranoto, Suyoto</i>	
Discriminating Cystic and Non Cystic Mass Using GLCM and GLRM-based Texture Features	346
<i>Hari Wibawanto, Adhi Susanto, Thomas Sri Widodo, S Maesadji Tjokronegoro</i>	
Fractal Terrain Generator	351
<i>Budi Hartanto, Monica Widiastri, Gunawan Widjaja</i>	
From Taiwan Puppet Show to Augmented Reality	356
<i>Yang Wang, Bo Ruei Huang, Zih Huei Wang</i>	
Generating Iriscode using Gabor Filter.....	362
<i>I Ketut Gede Darma Putra, Lie Jasa</i>	
Interpolation Technique to Improve Unsupervised Motion Vector Learning of Wyner-Ziv Video Coding.....	366
<i>I. M. Oka Widyantara, N.P. Sastra, D.M. Wiharta, Wirawan, G. Hendrantoro</i>	
Iris Segmentation and Normalization	371
<i>I Ketut Gede Darma Putra, I Nyoman Piarsa, Nazer Jawas</i>	
NEATS: A New Method for Edge Detection	377
<i>Maria Yunike, Suyoto</i>	
Online Facial Caricature Generator	383
<i>Rudy Adipranata, Stephanus Surya Jaya, Kartika Gunadi</i>	
Silny Approach to Edge Detection for Central Borneo Batik.....	387
<i>Silvia, Suyoto</i>	

Internet, Web Services & Mobile Applications

Cattle's Cost of Goods Sold System Information at CV Agriranch	392
<i>Lily Puspa Dewi, Yulia, Anita Nathania, Doddy Hartanto</i>	
Compensation Method for Internet Grids using One-to-many Bargaining	396
<i>Andreas Kurniawan, Pujiyanto Yugopuspito, Johan Muliadi Kerta</i>	
Mobile RSS Push Using Jabber Protocol.....	406
<i>Fajar Baskoro, Dwi Ardi Irawan</i>	
Teacher's Community Building Website to Facilitate Networking and Life-Long Learning	412
<i>Arlinah Imam Rahardjo, Yulia, Silvia Rostianingsih</i>	
Vision and Mission Educational Foundation (YPVM) Web-Based Project Management System	417
<i>Arlinah Imam Rahardjo, Yulia, Edwin</i>	
Web Based School Administration Information System on LOGOS School.....	421
<i>Djoni Haryadi Setiabudi, Ibnu Gunawan, Handoko Agung Fuandy</i>	

Communication Systems & Networks

Data Visualization of Modulated Laser Beam Communication System	427
<i>Zin May Aye</i>	
Development of Steganography Software with Least Significant Bit and Substitution Monoalphabetic Cipher Methods for Security of Message Through Image.....	432
<i>Iswar Kumbara, Erwin</i>	
Feasibility Analysis of Zigbee Protocol in Wireless Body Area Network	436
<i>Vera Suryani, Achmad Rizal</i>	
Mobile TV with RTSP Streaming Protocol and Helix Mobile Producer	439
<i>Yunianto Purnomo, Andrew Jaya Efendy</i>	
Quantitative Performance Mobile Ad-Hoc Network using Optimized Link State Routing Protocol (OLSR) and Ad-Hoc On-Demand Distance Vector (AODV).....	443
<i>Andreas Handojo, Justinus Andjarwirawan, Hiem Hok</i>	
Spatial Rain Rate Measurement to Simulation Colour Noise Communication Channel Modeling for Millimeter Wave In Mataram.....	449
<i>Made Sutha Yadnya, Gamantyo Hendrantoro</i>	
The Effect of Maximum Allocation Model in Differentiated Service-Aware MPLS-TE	453
<i>Bayu Erfianto</i>	

User Accounting System of Centralized Computer Networks using RADIUS Protocol	457
<i>Heru Nurwarsito, Raden Arief Setyawan, Handoko D. Fatikno</i>	
Wireless Data Communication with Frequency Hoping Spread Spectrum (FHSS) Technique.....	463
<i>Khin Swe Myint, Zarli Cho</i>	
Wireless LAN User Positioning using Location Fingerprinting and Weighted Distance Inverse	469
<i>Justinus Andjarwirawan, Silvia Rostianingsih, Charlie Anthony</i>	
WLANXCHANGE: A New Approach in Data Transfer for Mobile Phone Environment	474
<i>Ary Mazharuddin Shiddiqi, Bagus Jati Santoso, Rio Indra Maulana</i>	
 Control & Automation	
Analysis Influence Internal Factors on Fuzzy Type 2 Performance of Swing Phase Gait Restoration	479
<i>Hendi Wicaksono</i>	
Design and Construction of Wind Speed Indicator Based on PIC Microcontroller System	484
<i>Khin Mar Aye, Khi Tar Oo</i>	
Fault Diagnosis in Batch Chemical Process Control System using Intelligent System	489
<i>Syahril Ardi</i>	
Implementation of an Adaptive PID Controller using the SPSA Algorithm with Realistic Target Response.....	493
<i>Sofyan Tan</i>	
Induction Heating Efficiency Analysis Modeling Using COMSOL® Multiphysics Software.....	498
<i>Didi Istardi</i>	
Authors Index.....	504

Preface

First of all, I would like to give thank to God the Creator, God the Redeemer and God who leads us to the truth for all His blessings to us. As we all know, this 2nd International Conference on Soft Computing, Intelligent Systems and Information Technology 2010 (ICSIIT 2010) is held from 1-2 July 2010 in the Hard Rock Hotel located at this paradise island, Bali, Indonesia. I thank Him for His presence and guidance in letting this conference happen. Only by God's grace, we hope we could give our best for 2nd ICSIIT 2010 despite of all of our limitation.

We have received more than 130 papers from 15 countries. Only 96 papers from 13 countries have been accepted based on reviewers' ratings and comments. The paper selection process was based on full paper submissions. We thank all authors who have contributed and participated in presenting their works at this conference. We also gratefully acknowledge the important review supports provided by the 19 members of the program committee from 8 different countries. Their efforts were crucial to the success of the conference.

We are also so blessed by the presence of two invited speakers who will address the important trends relating to natural languages processing and soft computing. The first issue on natural language will be addressed by a lovely professor, Prof. Rachel Edita O. Roxas, Phd. who will present "Human Language Technology: the Philippine Context". We are aware that the main problem in language processing is ambiguity from syntax level to semantic level. In my personal opinion, we are also living in between inherently ambiguous and completely reasonable world. Einstein once said that "As far as the laws of mathematics refer to reality, they are not certain, as far as they are certain, they do not refer to reality." Prof. Rolly Intan, Dr.Eng will address this issue on soft computing with his presentation entitled "Mining Multidimensional Fuzzy Association Rules from a Normalized Relational Database".

I hope during your stay in this beautiful island you will enjoy and benefit both, the fresh sea breeze and harmonious sound from sea waves, as well as the intellectual and scientific discussions. I hope your contributions and participation of the discussion will lead to the benefit of the advancements on Soft Computing, Intelligent Systems and Information Technology.

Soli Deo Gloria,
Iwan Njoto Sandjaja
Conference Chair
ICSIIT 2010 Bali Indonesia

Organizing Committee

The first ICSIIT 2010 is organized by Informatics Engineering Department, in cooperation with the Center of Soft Computing and Intelligent System Studies, Petra Christian University, Indonesia.

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Search Engine Application Using Fuzzy Relation Method for E-Journal of Informatics Department Petra Christian University

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ABSTRACT

Nowadays, scientific articles are easily obtained, because many researchers who conduct research discover new things. However, the increasing number scientific articles is not accompanied by the availability of applications to assist in the search for relevant articles. Today, available search engine applications perform only a search process based on string matching of search terms. In this research, a search engine application based on keyword relevance by using fuzzy relationship was developed.

This search engine application is built using PHP programming language and mysql as its database. Windows XP is used as the operating system. The used methods in fuzzy relationship are keyword used to paper, paper to paper, and paper to keywords and keyword to keyword. In addition, the components used to convert pdf files into plain text format.

Based on the results of experiments conducted, the process of searching for the 25 articles takes less than 5 seconds. For the indexing process, it is influenced by the number of pages per article.

Keywords

Fuzzy Relation, Search Engine, Paper.

1. INTRODUCTION

At this time, journal is one of the many forms of documents selected by the researchers and scientists to put the results of experiments or research that have been conducted. Through the journal, the researchers poured all aspects of the research that been conducted by attaching a detailed information about the research he had conducted.

A journal as a medium of information from the experts/researchers to the public media has an important role and very strategic. For example in the field of education, the journal serves as a good material for teaching materials (for teachers) or as a reference for students to learn a new science.

Currently, website has been highly developed. This resulted in a website used as a medium of publication of a journal from experts/researchers to the public or known by the name of the e-journal. But more and more of the e-journal are not followed by the use of search engines technology. The search engine on each of the

e-journal that is useful to facilitate a user who wants to do a search on a journal and other journal/articles that may still relate to one another is needed.

The problem is how to design search engines on e-journal that can produce a related mutually journal to one another based on the keywords that are input by the user.

This paper presents a new search engine applications that do not only search on the similarity keyword provided by journal or scientific paper, but also provide a reference paper which relate to each other as well as journal is desired by the user.

The remaining part of this paper is organized as follows. Section 2 presents an overview of current proposal for dealing with fuzzy relation. Section 3 depicts the approach that we have delineated to solve the proposed problems. Section 4 discusses the performance of proposed methods. Finally, section 5 concludes the paper.

2. FUZZY RELATION

Fuzzy relation is a method for explaining the relationship of two different things (completely different). As illustration, the word "apple" (apple) and "tiger" (tiger) then in general the two words are not related. In general, the word "apple" refers to the name of the fruit and the "tiger" refers to the name of wild animal.

In the computer world there is manufacturer software, Macintosh (Mac). Mac has the brand "apple" so often referred to as the Apple Macintosh. Recently, Mac issued a new operating system called "Tiger" OS. From the relationship with Mac as the word "Apple" and "Tiger" is actually not related in general and in writing, have a relationship in the world of computers. Given the fuzzy relation then this kind of relationship will be examined with an assumption and goal that by knowing the relationship closeness/kinship between the two word/object. In relation to the world of search (searching), then by inserting the word "apple", there is the possibility of the word tiger will also be a result of output. Not because the results wrong, but because between the word "apple" and "tiger" there is kinship [4].

Explanation of fuzzy relation can also be described as follows: two words that completely unrelated (eg: "apple" and "tiger"), will have a relationship when both the word is addressed in one document. More and more documents that discuss both the relationship between the two words ("apple" and "tiger") will be getting closer.

Fuzzy Relation will search 4 links from a combination of words (keywords) and documents (paper) these relationships are:

- *Keyword to paper*
- *Paper to paper*
- *Paper to keyword*
- *Keyword to keyword*

Explanation of each of this relationship along with the calculation process is described as follows:

1. At this step is assumed relationship between the keyword to the weight of the paper has value to the paper of the following keywords:

$P = \{P_1, P_2, \dots, P_n\}$ is a set of papers

$D = \{D_1, D_2, \dots, D_n\}$ is a set of keywords

For example from the data obtained by paper and keyword relationship expressed as a fuzzy set of papers on the following keywords:

$$P_1 = \{0.3/D_2, 0.7/D_5, 1/D_7, 1/D_8\},$$

$$P_2 = \{1/D_2, 0.8/D_5, 0.8/D_7, 1/D_8\},$$

$$P_3 = \{0.9/D_1, 0.9/D_3, 1/D_4, 0.8/D_6\},$$

$$P_4 = \{1/D_1, 0.5/D_3, 0.8/D_4, 0.8/D_6\},$$

$$P_5 = \{0.1/D_2, 0.7/D_5, 1/D_4, 1/D_8\},$$

$$P_6 = \{0.9/D_2, 1/D_5, 0.8/D_4, 1/D_8\}$$

For $P = \{P_1, P_2, \dots, P_6\}$ and $D = \{D_1, D_2, \dots, D_8\}$, where each paper/document regarded as a fuzzy set of keywords so we get $\mu_{P_5}(D_1) = 0.1$.

2. *Similarity between 2 papers* expressed as a function of R where $R: P \times P \rightarrow [0,1]$ [5]

$$R(P_i, P_j) = \frac{\sum_D (\mu_{P_i}(D), \mu_{P_j}(D))}{\sum_D \mu_{P_j}(D)} \quad (2.1)$$

Where:

R: Relation

P_i : Paper/document i

P_j : Paper/document j

D: Keyword

μ : Membership function as a mapping $\mu_{P_i}: D \rightarrow [0,1]$.

Can find a relationship between a paper with one another, eg:

$$\begin{array}{ccc} \text{relation} & R(P_1, P_2) & \\ \frac{0.3 + 0.7 + 0.8 + 1}{1 + 0.8 + 0.8 + 1} = \frac{2.9}{3.6} & = & 0.78 \end{array}$$

The calculation of paper to paper as a whole can be seen in Table 1.

Table 1. Relation Paper to Paper

X / Y	P1	P2	P3	P4	P5	P6
P1	1,00	0,78	0	0	0,64	0,54

P2	0,93	1,00	0	0	0,64	0,73
P3	0	0	1,00	0,97	0,36	0,22
P4	0	0	0,83	1,00	0,29	0,22
P5	0,60	0,50	0,28	0,26	1,00	0,70
P6	0,67	0,75	0,22	0,26	0,93	1,00

3. From the existing data of keywords related to the paper, then we will get the paper on the relationship between keywords. Relationship of paper to keyword can be calculated using formula 2.2 [5]:

$$H_{D_j}(P_j) = \frac{\mu_{P_i}(D_j)}{\mu_{P_i}(D_1) + \mu_{P_i}(D_2) + \dots + \mu_{P_i}(D_m)} \quad (2.2)$$

Where:

R: Relation

P_i : Paper/document i

P_j : Paper/document j

D: Keyword

μ : Membership function as a mapping $\mu_{P_i}: D \rightarrow [0,1]$.

Example: Calculate the weight of keyword (d2) for paper 1

$$\eta_{D_j}(P_j) = \frac{0.3}{0.3 + 0.7 + 1 + 1} = \frac{0.3}{3} = 0.1$$

so the final result is:

$$D_1 = (0.25/P_3, 0.32/P_4),$$

$$D_2 = (0.1/P_1, 0.28/P_2, 0.06/P_5, 0.24/P_6),$$

$$D_3 = (0.25/P_3, 0.16/P_4),$$

$$D_4 = (0.28/P_3, 0.26/P_4, 0.36/P_5, 0.27/P_6),$$

$$D_5 = (0.23/P_1, 0.22/P_2, 0.25/P_5, 0.27/P_6),$$

$$D_6 = (0.22/P_3, 0.26/P_4),$$

$$D_7 = (0.33/P_1, 0.22/P_2),$$

$$D_8 = (0.33/P_1, 0.28/P_2, 0.36/P_5, 0.27/P_6)$$

4. *Similarity between 2 keywords* expressed as a function of R where $R: D \times D \rightarrow [0,1]$ as written in the formula 2.3 [5]:

$$R(D_i, D_j) = \frac{\sum_P \min(\eta_{D_i}(p), \eta_{D_j}(p))}{\sum_P (\eta_{D_i}(p))} \quad (2.3)$$

Where:

R: Relation

P_i : Paper/document i

P_j : Paper/document j

D: Keyword

μ : Membership function as a mapping $\mu_P: P \rightarrow [0,1]$.

can be found the relationship between keywords with each other eg.:

$$\text{relation } R(D_1, D_3) = \frac{0.25 + 0.16}{0.25 + 0.16} = 1$$

$$\text{relation } R(D_3, D_1) = \frac{0.25 + 0.16}{0.25 + 0.32} = 0,72$$

Calculation of *keyword to keyword* as a whole can be seen in Table 2.

Table 2. Relationship between Keyword to Keyword

X/ Y	D1	D2	D3	D4	D5	D6	D7	D8
D1	1,0 0	0	1,00	0,44	0	1,00	0	0
D2	0	1,0 0	0	0,26	0,6 4	0	0,5 8	0,53
D3	0,7 2	0	1,00	0,35	0	0,79	0	0
D4	0,8 9	0,4 4	1,00	1,00	0,5 4	1,00	0	0,51
D5	0	0,9 1	0	0,44	1,0 0	0	0,8 2	0,86
D6	0,8 4	0	0,93	0,41	0	1,00	0	0
D7	0	0,4 7	0	0	0,4 6	0	1,0 0	0,49
D8	0	1,0 0	0	0,54	1,0 0	0	1,0 0	1,00

3. SEARCH ENGINE APPLICATION

Chapter 3 describes the design of systems that are the basis of the developing the application of scientific journal search engines in this research. Basically there are two main processes in this application; they are the indexing process and searching process. Indexing process takes the longest runtime when compared with the process of searching. It is caused by a cutting process of a document into a word. Indexing process execution depicted in Figure 1.

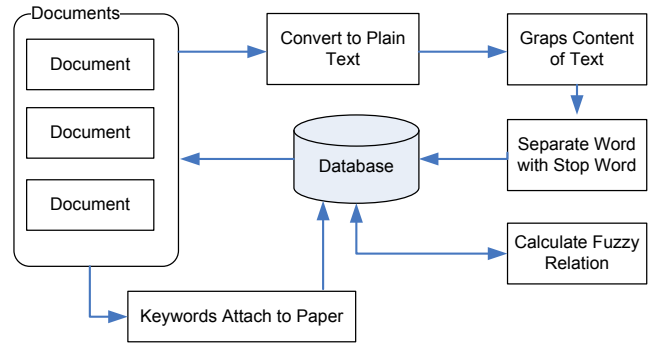


Figure 1. Indexing process

Here is a sequence of description of the indexing process:

1. Retrieve a document that has no plain text file / not yet indexed.
2. Convert the pdf documents into plain text files that are readable by the programming language PHP 5.
3. Input a plain text file data into the database to be stored and through the next process.
4. Read the contents of plain text files and store a long string into an array.
5. Enter a keyword from a document originating from the author to serve as the keyword / main keywords on applications and enter into a database. Keyword is better known by the name of keywords attached to paper.
6. Grab a few sentences from the abstract and titles for snipset when displaying search results on the process of searching.
7. Take the author's name and affiliation to be used in the process of searching with the author and affiliation search mode.
8. Rupture long string that is stored in an array into a word-per-word and separate from the existing stop word. Next save all the words that have been cut into the database and delete its stop word.
9. The last process of this indexing process is the process of calculating the value of fuzzy relations.

■ Searching Process

The search engine used 2 kinds of fuzzy methods to process the searching process, both methods are:

a. Ordinary Fuzzy Method

Ordinary fuzzy method is used when a user input keyword has never been through the process of indexing, but the keywords are included on one or more papers that are stored on the system.

In this method, the fuzzy value calculation is only carried out on the basis of number of word occurrence; it means the fuzzy value calculation is performed only for papers that have keyword input on its content. This method involves only one fuzzy process has been done before in the indexing process, it is the calculation of keywords to paper fuzzy.

b. Extended Fuzzy Method

Unlike the ordinary fuzzy method, the calculation by this method not only involves the number of word occurrence alone but also involves all fuzzy calculations have been

done on indexing process. With this method, papers that do not have keyword input on its content will be found.

The use of two methods is for the speed/runtime purpose when the searching process is running. In this search engine, users can not choose the method that will be used, because the system will automatically check the incoming keyword to further select one of two methods for implementing the process of searching. General description of the process of searching can be seen in Figure 2.

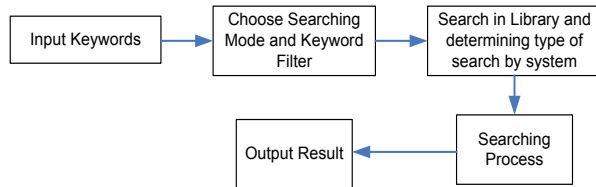


Figure 2. Searching process

4. EXPERIMENTS

In this section, we present an experimental result of new search engine application. This system was built in PHP [1, 2, 3] on a PC with 2.4 GHz Pentium ® 4 CPU and 1 GB of RAM under MS Windows XP Pro.

4.1 Searching Type - *Extended Fuzzy*

Search by extended fuzzy type is a searching type which looks for related papers of related keywords that are input by the user. The implementation of an extended type of fuzzy search with keyword input - one word can be seen in Figure 3.

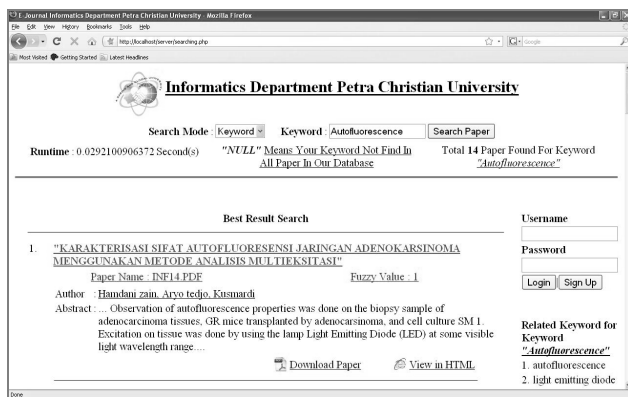


Figure 3. Extended type of fuzzy search with keyword input - one word

The implementation of an extended type of fuzzy search with a keyword input more than one word/phrase can be seen in Figure 4.

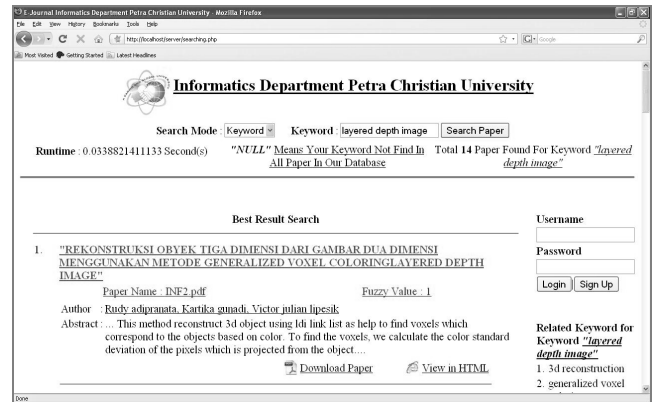


Figure 4. Extended type of fuzzy search with keyword input – more than one word/phrase

4.2 Searching Type - *Ordinary Fuzzy*

Searching by ordinary fuzzy type is a search that only looks for keywords in the paper, inputted by the user. Ordinary type of fuzzy search implementation with a single word keyword input can be seen in Figure 5.

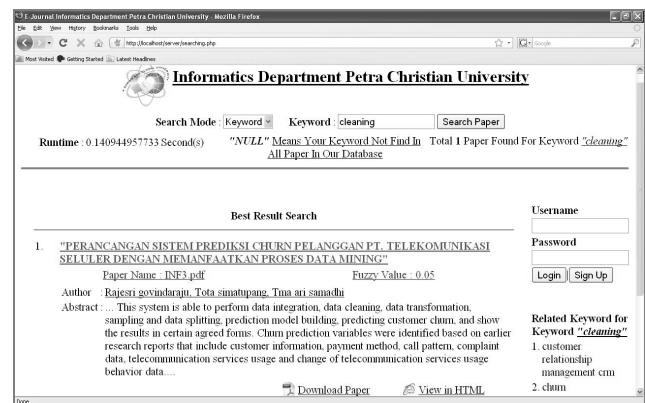


Figure 5. Ordinary type of fuzzy search with a single word keyword input

Ordinary type of fuzzy search implementation with the input of more than one word keywords/phrases can be seen in Figure 6.

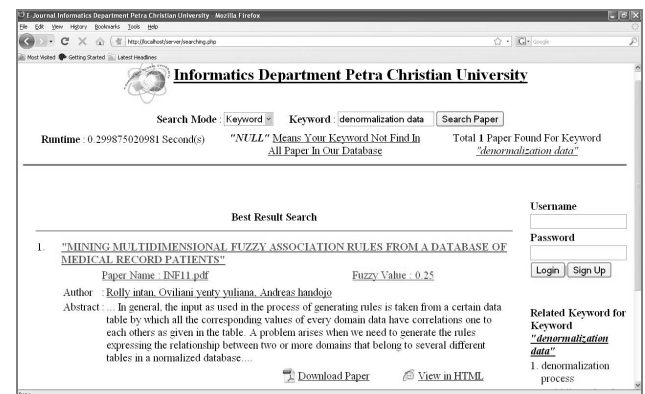


Figure 6. Ordinary type of fuzzy search with more than one work/phrase keyword input

4.3 Search involving symbol and *Stop Word*

In addition to testing with the extended fuzzy search types and ordinary fuzzy, involving a stop word and symbol are also important. This is related to all rules that apply to the program. All these rules are based on assumptions that are not researched before, but just based on observations from the passage of searching module developing. In addition, this test is also a test of all rules that apply to the application.

The Implementation of the search involving symbol and stop word with one-word keywords can be seen in Figure 7.

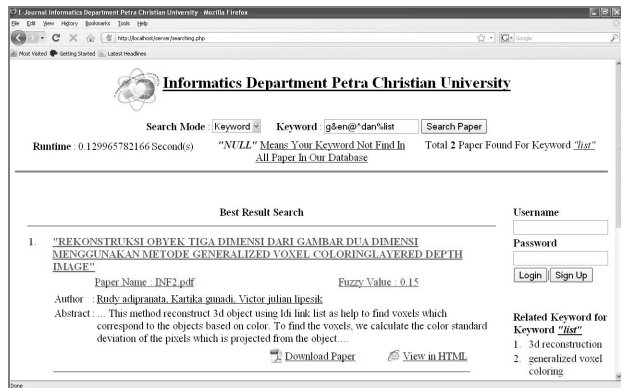


Figure 7. Search involve symbol and stop word with one word keyword input

Search engine implementation which involves symbols and stop word to the keyword input of more than one word/phrases can be seen in Figure 8.

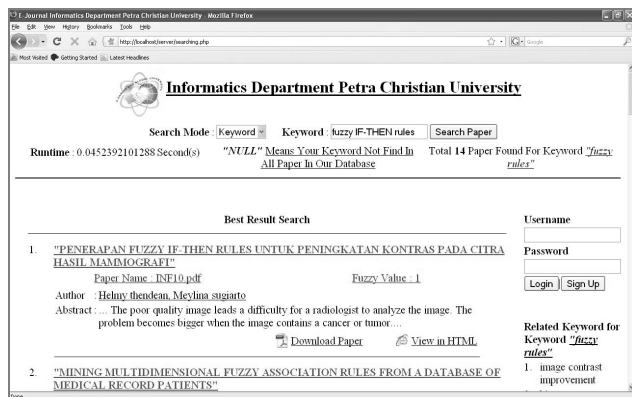


Figure 8. Search engine which involves symbol and *stop word* with more than one word/phrase keyword input

4.4 Searching involves *Keyword Attach to Paper*

Searching involving keyword attached to paper is a searching process performed on the input found on the library tables. This Search use extended fuzzy type because the keyword input is found in the library table. Search engine implementation involves keyword attached to paper with one word keyword input can be seen in Figure 9.

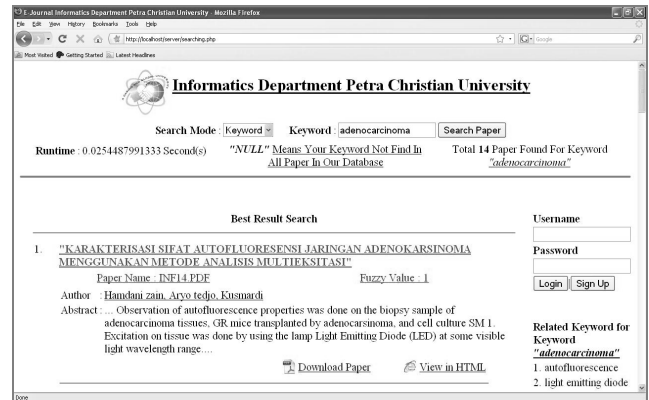


Figure 9. Search engine which involves *keyword attach to paper* with one keyword input

Search engine implementation which involves keyword attach to paper with more than one word/phrases input can be seen in Figure 10.

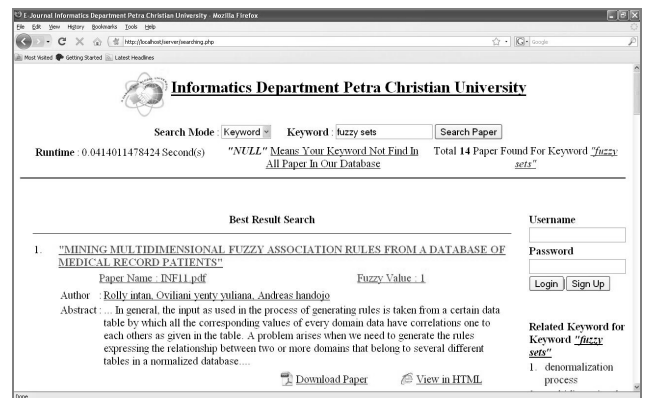


Figure 10. Search engine which involves *keyword attach to paper* with more than one word/phrase keyword input

4.5 Runtime Process

From the experiments conducted, it can be calculated an average speed of the process of searching on search engine applications. The average results of the calculation process of some kind of keyword search can be seen in Table 3.

Table 3. Runtime test result

User inputted Keyword	Runtime (second)
Autofluorescence	0.0254549980
layered depth image	0.0606830120087
Data	0.0613670349121
denormalization data	0.343075037003
g&en@^e\$rate	0.105587005615
fuzzy IF-THEN rules	0.261485099792

adenocarcinoma	0.0284929275513
fuzzy sets	0.0446968078613
The Average of Runtime	$0.8831452369523/8 =$ 0.1103931546190375

From 8 keywords input in the system, the average of searching process is 0.1103931546190375 seconds.

Runtime test of indexing process is the main focus of all the testing and experiments performed on the system. From several experiments, it is resulted that more and more number of papers and the number of keywords, the runtime required to complete the indexing process is also getting bigger. From the seventh step in the indexing process, step-core indexing and fuzzy relationship value calculation takes the greatest runtime. The example of execution indexing process is presented in Figure 11.

```

C:\WINDOWS\system32\cmd.exe
Perhitungan Keyword to Paper pada semua Dokumen Telah Selesai Dilakukan
Perhitungan Paper to Paper pada Dokumen sifat.pdf Telah Selesai Dilakukan
Perhitungan Paper to Paper pada Dokumen infor1.pdf Telah Selesai Dilakukan
Perhitungan Paper to Paper pada Dokumen infor2.pdf Telah Selesai Dilakukan
Perhitungan Paper to Paper pada Dokumen victor.pdf Telah Selesai Dilakukan
Perhitungan Paper to Keyword pada Dokumen sifat.pdf Telah Selesai Dilakukan
Perhitungan Paper to Keyword pada Dokumen infor1.pdf Telah Selesai Dilakukan
Perhitungan Paper to Keyword pada Dokumen infor2.pdf Telah Selesai Dilakukan
Perhitungan Paper to Keyword pada Dokumen victor.pdf Telah Selesai Dilakukan
Perhitungan Keyword to Keyword pada semua Dokumen Telah Selesai Dilakukan

Note : Semua Dokumen pada Database Telah Melalui Proses Indexing Tahap 2
runtime = 1228.71254396 detik
C:\Program Files\WertrigoServ\Php>_

```

Figure 11. Indexing process

From the testing process it can be described that it takes 1228.71254396 seconds or approximately 20 minutes 5 seconds to index four papers.

5. CONCLUSION

This paper deals with the implementation of fuzzy relation method to support e-journal search engine. Fuzzy value ranking system should be implemented into the calculation of fuzzy relations with respect to the accuracy of produced output.

The Implementation of search engine applications on operating systems other than Windows XP can be done by changing some parts of the segment of the program and replace the use of customized components with the operating system used.

The emphasis of this paper was on feasibility – identification of possible approaches and development of methods to put them into practices.

We are currently working on the implementation process of indexing and searching in a lot of server/multi server. Next, concerns is the quality of the result.

6. REFERENCES

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